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# THE EXPECTED TRENDS IN ROLLED STEEL CONSUMPTION FROM THE POINT OF VIEW OF PRODUCT MIX IN DEVELOPING COUNTRIES, WITH SPECIAL REFERENCE TO UAR EXPERIENCE.

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## INTRODUCTION

It is a generally accepted fact that developing countries are compelled to industrialize sooner or later if they are to attain and maintain a high standard of living.

The steel industry is a basic heavy industry and becomes a necessity once a certain level of industrialization is attained.

It should be emphasized that a unified steel standards for Africa should be established in the immediate future. The UAR has already changed from the inch system to the metric system. The unification of standards will help in the exchange of products and allows for better marketing and economic operation.

In this paper a short survey of the existing steel plants in the UAR and the production achieved is outlined and it will be seen that increase in production has been reached, in the different plants. This is mainly due to modernization, more functional organization of labour and experience.

The study is based on the experience gained in the UAR, the tendency in the change of pattern of finished products in different countries of the world and detailed statistics of their products.

By analysing the different trends of product mix, the local demands and the actual consumption of steel in Africa, proposals are given to show a model pattern of product mix in developing countries.

Any solution under study for a particular case should take into consideration local conditions. The decision depends on economic conditions, raw material resources and the programme for industrial development.

## HISTORY OF THE STEEL INDUSTRY IN UAR

The steel industry had started in 1948 by private companies and in 1954 the Egyptian Iron and Steel Company was created.

These companies for rolling production are:

- The Egyptian Copper Works, Alexandria.
- The Delta Steel Mill, 5 kilometers from Cairo.
- The National Metal Industries, 20 kilometers from Cairo.
- The Egyptian Iron & Steel Company, 30 kilometers from Cairo.

The following is a brief description of these companies and their capacities

## THE EGYPTIAN COPPER WORKS

The Egyptian Copper Works is established in Alexandria. In 1948 a melting shop and a rolling mill for reinforcement bars were erected.

The steel melting shop is equipped with two open hearth furnaces of 28 tons capacity each.

The furnaces are fired by fuel oil and have an annual capacity of 60.000 tons of ingot steel per annum. The furnace charge is almost exclusively scrap.

Rolled Product

Rounds 8 mm - 28 mm

Rolling Mill

1 pusher type furnace
1 three high roughing stand 500 mm diam.
3 intermediate stands.
7 finishing stands
1 rack type cooling bed and 3 garret reels.

The mill can produce 6000 tons/month in three shifts operation.

Wire Drawing

Pilot plant.

Production

60.000 tons/year of round bars.

## DELTA STEEL MILL

The steel melting shop of this plant comprises of two electric arc furnaces viz:

- 1 furnace of 12-15 tons capacity and an installed electric capacity of 4000 kw.
- 1 furnace of 15-18 tons capacity and an installed electric capacity of 6000 kw.

Production

The output is 50.000 tons/per annum of ingot steel.

Steel scrap is charged.

The ingots weighing 160 kgs. poured in the steel melting shop are rolled to rounds 8-30 mm diam.

The rolling mill is equipped with

1 pusher type furnace of 8 tons hourly output

1 three-high roughing mill of two stands

1 three-high finishing mill of 7 stands

Foundry

- The works own also a foundry with a hot blast cupola plant of about 4 tons/hr. output.
- 2 electric furnaces of 3 tons capacity each and an installed electric capacity of 1000 kw. each.
- The cast iron is used for jobbing castings and for the manufacture of centrifugal cast pipes up to 150 mm diam.

Wire drawing

- There is a modern plant for drawing of wire.

This mill is now modernized to have automatic operation and a large part of the production will be in coils and in high quality Steel 52.

## NATIONAL METAL INDUSTRIES

In the steel works of this enterprise about 50.000 tons of steel ingots per annum is produced. It comprises two oil 25 tons open hearth furnaces. The steel is poured into ingots weighing about 150 kgs. each.

The steel is then rolled into reinforcement bars of 8 mm to 25 mm. The mill consists of:

1 single stand roughing mill.

2 finishing mills of 7 stands each.

1 cooling bed.

Production / year 60,000 tons.

THE EGYPTIAN IRON AND STEEL COMPANY

The Egyptian Iron and Steel Company is the only integrated steel-producing enterprise in Egypt, at the present time, having a potential steel ingot capacity of approximately 315,000 metric tons per year. The plant is located near Helwan about 30 kilometers south of Cairo on the River Nile.

Erection started in 1956 and operation commenced in 1958. All units were put into operation by June 1960.

Basic producing units include two 5.1 meter hearth diameter blast furnaces, three 15 ton Thomas Converters, and two 12 ton electric arc scrap melting furnaces. The rolling mills comprise of one 900 mm blooming and slabbing mill, a three-stand 750 mm medium heavy section mill, a 750 mm three-high plate mill, and a 750 mm two-high sheet mill. A sintering plant and small section mill were put into operation in May 1964.

The construction of a semicontinuous hot strip mill, cold rolling mills, tinning and galvanizing plant is under way. This plant is scheduled to go into production in 1968. The strip mill will have a maximum width of 1000 mm.

Iron Ore is mined at Aswan and transported from a distance of 950 kilometers, in 50 tons railway hopper wagons to the steel plant. Limestone from the quarries at Refaii is delivered by railroad to the steel plant from a distance of 15 kilometers.

Metallurgical coke for the bast furnaces is supplied by a coking plant in the vicinity of the steelworks. Coke is manufactured from imported coking coal. The steel company owns and operates the Aswan iron ore mines and the Refaii quarries.

Original Production Programme, As Determined in 1954

| | | | |
|---|---|---|---|
| 1. | RAILS (Type K 47, K 54.5) | tons/annum | 10.000 |
| 2. | SLEEPERS | " " | 23.000 |
| 3. | FISHPLATES. | " " | 1.000 |
| 4. | HEAVY SECTIONS (UNSPECIFIED) | " " | 46.000 |
| 5. | HEAVY PLATES (10-24) x 1.5 m | " " | 20.000 |
| 6. | MEDIUM PLATES (6-10 mm) x 1.5 m | appr. | 14.000 |
| 7. | THIN SHEETS (1-3 mm) 1 x 2 | " | 6.000 |
| 8. | BILLETS | " | 80.000 |
| | | TOTAL | 200.000 |

This production programme was modified with regard to the heavy sections and the following is the programme as determined in 1957.

| Equal Angles | Channels |
|---|---|
| L 70 x 70 x 7 | U NP 10 |
| L 80 x 80 x 8 | U NP 12 |
| L 90 x 90 x 9 | U NP 14 |
| L 100 x100 x10 | U NP 16 |
| L 120 x120 x11 | U NP 26 |
| L 150 x150 x14 | |

| Unequal Angles | I Beams |
|---|---|
| L 50 x 100 x 8 | 1 NP 12 |
| L 80 x 120 x 8 | 1 NP 14 |
| L 100 x 150 x 10 | 1 NP 16 |
| | 1 NP 26 |

Sheet Bars
300 x (8 - 24) mm
400 x (10- 24) mm

Rails 52 kg/m

Sleepers for rails 52

Rounds 50 - 122 mm

Squares 50 - 140 mm

Since the initial start of operations during 1958, 1959 and 1960, the production of ore, iron and steel has increased as follows:

Semi finished and finished products in the Egyptian Iron & Steel Co. in tons.

| Productd (semifinished & finished). | 1959 | 1960 | 1962 | 1964 |
|---|---|---|---|---|
| Blooming mill | 84852 | 122909 | 151200 | 140611 |
| Blooms for sale | 33600 | 55500 | 68600 | 30796 |
| Heavy sections | 24767 | 35233 | 45094 | 61180 |
| Light section | - | - | - | - |
| Rounds and wires | | | | 9052 |
| Plate mill | 12823 | 25755 | 28291 | 31972 |
| Sheet mill | 6873 | 8204 | 8224 | 9838 |

This table indicates the increase in rolled products and decrease of blooms for sale with regard to the year.

Strip Mill

In 1961 a contract was concluded for the delivery of a semi-continuous hot & strip mill, 1 meter wide, having the following production programme:

Production Programme (tons/year).

In 3 Stages:

| Hot rolled sheets | 1st stage | 2nd stage | 3rd stage |
|---|---|---|---|
| 1- Strips for pipes (2-6) mm | 40.000 | 120.000 | 170.000 |
| 2 - Carbon Steel (2-7) mm | 40.000 | 120.000 | 170.000 |
| Sheets for different purposes TOTAL | 80.000 | 240.000 | 340.000 |

Cold rolled sheets

| | | | |
|---|---|---|---|
| 1- Carbon Steel Sheets (0.5-2.5 mm) (deep & extra deep drawing) | 45.000 | 140.000 | 200.000 |
| 2- Hoops and bands (0.3-2 mm) | 25.000 | 70.000 | 110.000 |
| 3- Tin plate (0.2-0.55 mm) | 45.000 | 45.000 | 45.000 |
| 4- Black polished sheets (0.2-0.56) | 5.000 | 5.000 | 10.000 |
| TOTAL | 120.000 | 260.000 | 410.000 |
| TOTAL PRODUCTION | 200.000 | 500.000 | 750.000 |
| Parts of cold rolled sheets will be in : | | | |
| - Galvanized sheets | 10.000 | 20.000 | 20.000 |
| - Corrugated sheets | 5.000 | 10.000 | 10.000 |

DISCUSSION FOR CHOICE OF TYPE OF STRIP MILL

Before deciding the capacity and type of the installation required for strip manufacturing, for the above mentioned programme a short essay was made on the main typical installations which are:

| | Anual production |
|---|---|
| (1) Steckel hot strip mill and reversing cold mill. | 120.000/300.000 |
| (2) Semi-continuous hot strip mill and reversing cold mills. | 300.000/800.000 |
| (3) Semi-continuous hot strip mill and tandem cold mill. | 500.000/1.250.000 |
| (4) Continuous hot strip mill and tandem cold mills. | 1.250.000/2.500.000 (depending on the width & thickness of the strip) |

It is clear that no one of these plants will be capable of producing the full of products from the lowest to the highest grade. In our case it should be foreseen the possibility of importation of certain items.

For UAR a normal minimum final gauge of .2 mm was decided upon this gauge allowing for rolling to tinplate gauge.

Continuous rolling mills, with their very large output, were considered to be too expensive for us, and the output associated with such a system was considered to be too high. An alternative considered was a semi-continuous mill, where the operation of the first four stands in a continuous mill is combined in one reversing roughing stand, the slab being reduced in several reversing passes.

A further attempt to reduce the initial capital cost led to the invention of the Steckel mill, in which a reversing rougher is followed by a reversing finisher and the strip is coiled in furnaces on either side of the finisher during each of the five finishing passes to avoid the temperature loss which would occur on a single stand finisher.

The Steckel Mill shall be abandoned because of the following reasons:

(1) There will be a difference in thickness of the strip either between the ends of the coils or between the centre of the strip and the sides which should not be more than 2 mms and which cannot be always guaranteed by Steckel mill. So, the yield will be lower with this mill than with semi-continuous mill.

(2) Hos rolled coils rolled on Steckel mill cannot be cold rolled on a Tandem mill. Although it is not necessary in the 1st. stage of the production of strip mill to erect the cold tandem mill but the possibility should be there when it is needed to make use of it.

(3) Operation of Steckel mill is more complicated than semi-continuous strip mill and Steckel mill does not allow further expansion or conversion.

(4) Steckel mill has a limited capacity and it is ideal for rolling stainless, silicon steels, but these are of limited use in our country.

(5) As a big part of our production is foreseen for export, so it should be of quality competitive to World market.

In view of the above and due to very high initial investment of continuous strip mill, we decided that the semi- continuous strip mill is convenient for our requirements.

We did not include in our installation a slabbing mill to feed the semi continuous strip mill, as it is now a common practice to use slabs from continuous casting

REASONS FOR THE CHOICE OF THE WIDTH OF STRIP TO BE: 1 m:

(1) It covers most of our requirements.
(2) It is an international width.
(3) The cost of initial investment is not too high compared with wider strips.
(4) This mill can produce about 800.000(T.annum)
(5) There is a possibility of exportation of strips of maximum 1 m. width
(6) Motor car body industry needs a part of the sheet of widths more than one meter. This can be overcome by:-
a- Using welded sheets which was a common practice before the installation of wide strip mills.
b- Importing these certain wide widths.

Production of Reinforced Concerete Bars and Wires

Detailed statistics were made on the production of reinforced concrete bars and wires between 1957 and 1964 and it was as follows:

| Year | Qty. Tons | Percentage increase compared with 1957 |
|---|---|---|
| 1957 | 107.000 | - |
| 1959 | 142.000 | + 33.1 |
| 1960 | 169.000 | + 58 |
| 1962 | 197.000 | + 84 |
| 1964 | 202.000 | + 88 |

From the above table we can conclude the following:

In considering the whole main production from QUANTITY SIDE during 1957,1959,1960,1962, and 1964 we can find out that the production shows a marked increase during these years.

The increase has been attained for all dimensions of bars during the different years with the exception of bars of large diam. (32, 38 and 45 mm). These dimensions showed a decrease during the statistical years due to the substitution of these dimensions by smaller ones of a different type known as "cold deformed bars".

Most of the production was in the dimensions 10, 13 and 16 mm, the reason is that these dimensions are commonly used in large construction projects.

TABLE I

STEEL IMPORTS IN
UAR

| P R O D U C T S | 1961 | 1962 | 1961 | 1962 |
|---|---|---|---|---|
| Slabs and ingots | 2997 | 16091 | | |
| Hot rolled plates | 5475 | 1910 | | |
| Ship plates | 468 | 645 | | |
| Hot rolled black sheets | 1282 | 351 | | |
| Cold rolled sheets | 12115 | 13255 | | |
| Galvalized sheets | 2572 | 5460 | | |
| Tin-Plates | 6730 | 8324 | | |
| Electrolytic tin sheet | 6502 | 9140 | | |
| Different quality of sheets | 3 | 57 | | |
| Corrugated galvanized sheets | 61 | 399 | | |
| Checquered plates | 1218 | 173 | | |
| Stainless sheets | 513 | 1208 | 36939 | 40392 |
| Wire bars in coils | 327 | 13185 | | |
| Wires for wire drawing | 3110 | 2772 | | |
| Galvanized wire | 61 | 63 | | |
| Different quality bars | 265 | 734 | | |
| Balinh hoops | 3653 | 5134 | | |
| Different quality hoops ballings | 435 | 127 | | |
| Round bars | 7052 | 16652 | | |
| Round concrete wires | 4035 | 5367 | | |
| Square bars | 408 | 3565 | | |
| Flats | 2879 | 10871 | 61648 | 58470 |
| I Beams | 100 | 1373 | | |
| Channel | 646 | 2721 | | |
| Equal angles | 2833 | 13359 | | |
| Unequal angles | 371 | 319 | | |
| T sections | 669 | 153 | 4619 | 17925 |
| Window sections | 3230 | 4065 | | |
| Sheet piles | 30616 | 8862 | | |
| Rails vignol | 769 | 2478 | | |
| Rails tramway | 283 | 671 | | |
| Sleepers | 1031 | | | |
| Other sleepers | 602 | 85 | | |
| Fish-plates | 4641 | | | |
| Clips | 1 | 316 | | |
| Accessories to railways | 687 | 2 | 8014 | 3552 |
| Flats steel-spring steel | 1431 | 16040 | | |
| Flats - alloy steel | 15 | 390 | | |
| Hexagonal bars | 36 | 155 | | |
| Tools steel | 30 | 39 | 1512 | 2188 |
| TOTAL PRODUCTS | 110152 | 123075 | | |

This table shows that the bulk of imported steel:

| | 1961 | 1962 |
|---|---|---|
| Flats | 33% | 33% |
| Rounds | 55% | 47% |
| Sections | 4% | 14.7% |
| Rolling stock material | 7% | 2.7% |
| Tool steel | 1% | 2.6% |
| | 100% | 100.0% |

This goes with the trend of industrialization of domestic goods and shows that the imported materials are mainly flats and rounds. This was taken in consideration in the expansion programme.

TABLE 2

PROGRAMME FOR EXPANSION IN UAR AND PRODUCT MIX
as decided in the 2nd five year plan

| Finished products | 1970 | 1972 |
|---|---|---|
| Heavy sections | 125000 | 125000 |
| Light sections | 40000 | 40000 |
| Plates | 750000 | 75000 |
| Medium sections | 200000 | 200000 |
| Hot rolled sheets & strips | 240000 | 240000 |
| Cold rolled sheets & strips | 260000 | 260000 |
| Reinforced concrete bars and wire (4 existing mills) | 310000 | 310000 |
| New Aswan steel plant Round and Wires (6-13 mms) | 300000 | 300000 |
| New wide plate mill (1st. stage) Possibly to be installed in Alexandria | - | 200000 |
| TOTAL: | 1.550.000 | 1.750.000 TONS |

According to this expansion programme the steel consumption per inhabitant per year will attain about 50 kg. in 1970.

This production programme will be as follows:

SECOND FIVE YEAR PLAN 1965-1970

(1) The Egyptian iron & steel Co.,

(i) The finished rolled steel production is estimated to be equal to approx. 1.2 million tons per year proceeding from the total volume of steel production at the works, which shall be 1.5 million tons of continuously cast semis.

The assortment of rolled products and the production volume by kinds of products are as follows:-

Rolled Products

(i) Heavy Sections

(1) Rounds 50-125 in diameter
(2) Squares 60-140 mm — 125.000 t
(3) Angles 100-150 mm
(4) Channels & I beams 140-260 mm
(5) Rails 16 to 52 kg/m in weight
(6) Sleepers 250 x 85 mm
(7) Sheet piling 400 x 84 mm (Larsen type)
(8) Sheet bars, 150-300 mm wide

(ii) Medium Sections

(1) Rounds 40-80 mm in diameter
(2) Squares 40-80 mm — 100.000 to be increased to
(3) Angles 50-90 mm — 200.000 to at a later stage
(4) Channels & I beams up to 120 mm
(5) Rails up to 16 kg/m
(6) Sleepers for these rails
(7) Flats 50-150 mm wide

(iii) Light Sections

(1) Rounds 6-38 in diameter — 100.000 t
(2) Squares 6-32 mm
(3) Angles 30-40
(4) Flats 20-100 mm wide

(iv) **Plates**

Thickness 5-25 mm 75.000 t
width up to 1500 mm
length 3-6 m

(v) Hot and Cold Sheet Steel

Assortment and production volume of the sheet steel are to be in accordance with the Projected 2nd stage of construction of the hot and cold strip mills (500.000 t including strips for cold forming mill), to be increased to 750.000 t at a later stage.

(vi) Cold Formed Sections (using coils from strip mill)

Cold formed sections of medium dimension range-40.000 t to be increased to 100.000 per year at a later stage.

(vii) Blooms for Re-rolling at other mills

Cross section 140 x 140 to 180 x 180 mm about 350.000 t/year during the first stage and none at a later stage. (see following item No.3)

Steel Qualities

(1) For structural sections - steel 37.42 and 52 (DIN)
(2) Rail steel.
(3) For plates-steel 37,42,52, shipbuilding quality and pressure vessel quality.
(4) For sheets - in accordance with market requirements.

2. Increase of rolled products production at the Works is planned to be reached by

(1) Erection of a new medium-section mill; and(2) by completion of the 2nd stage of the hot and cold strip mills. (3) A cold forming mill will be erected as well, together with a fabricated sections line to diversify the production of sections.

3. Proceeding from the steel balance at the works, to study a possibility of erecting a wide plate mill for the production of 200.000 to 250.000 tons of plates per year.

The plate dimensions are as follows :

5 - 24 mm thick
up to 2500 mm wide
up to 12 m long.

Also to consider the possibility of production of plates up to 2750 mm wide and up to 25 m long at the rolling mill.

As to this item No.3 this is the base of an integral steel plant at Alexandria.

This project is still under study and no definite decision is taken. The following table 3 indicates that: -

The steel production in Egypt began in 1948 by rod and wire mills only. The production increased from 50,000 tons (100 per cent in 1950 to 202040 tons in 1964 thus representing 61,6 per cent of the total production of steel. It will represent 39 per cent in 1972 of the total steel production.

The production of flat products started in 1959 beginning by an annual production of 19696 tons representing 8.9 per cent of the total production and reached 41810 tons in 1964 representing 12,4 per cent of the total production, thus conforming with the international trend.

The production of light sections will start in 1965 by an annual production estimated at 30000 tons.

The introduction of cold formed sections by adding a plant in 1970 to produce 40.000 tons in the 1st stage, to be increased to 100,000 tons at a later stage will cover the demand for structural sections together with the products of the existing mills.

Table 4 shows the consumption of steel in different countries of the world in different periods, and the steel consumption per inhabitant.

The average in the whole world is 121 kg/capita.

TABLE 3
PRODUCTION OF FINISHED STEEL PRODUCTS DURING 1959, 1960, 1962, 1964 AND EXPECTED PRODUCTION 1965, 1970 & 1972 (TONS AND PERCENTAGE)

| Year | Total | Heavy sect. | Light sect. | Rounds & Wires | Plates | Sheets | Re-rolling | Hot rolled sheets & strips | Cold rolled sheets & strips | Medium sections |
|---|---|---|---|---|---|---|---|---|---|---|
| 1950 | 50000 (100) | - | - | 50000 (100) | - | - | - | - | - | - |
| 1959 | 220063 (100) | 24767 (11.2) | - - | 142000 (64.5) | 12823 (5.8) | 6873 (3.1) | 33600 (15.2) | | | |
| 1960 | 293692 (100) | 35233 (11.9) | - | 169000 (57.5) | 25755 (8.2) | 8204 (2.7) | 55500 (18.2) | - | - | - |
| 1962 | 347209 (100) | 45094 (12.9) | - | 197000 (56.7) | 28291 (8.1) | 8224 (2.3) | 68600 (19.1) | - | - | - |
| 1964 | 335826 (100) | 61130 (12.1) | - | 202040 (61.6) | 31972 (9.5) | 9838 (2.9) | 30796 (9.1) | - | - | - |
| 1970 | 1550000 (100) | 125000 (8.1) | 40000 (2.1) | 610000 (39 | 75000 (4.8) | | | 240000 (15.4) | 260000 (16.7) | 200000 (12.9) |
| 1972 | 1750000 (100) | 125000 7 % | 40000 2 % | 610000 35 % | 275000 16 % | | | 240000 14 % | 260000 15 % | 200000 11 % |

TABLE 4

TOTAL PRODUCING OF STEEL IN SOME MAIN COUNTRIES

| 1963 Production of | USA | USSR | West Germany | Japan | Great Britain | France | Italy | China | World |
|---|---|---|---|---|---|---|---|---|---|
| Steel in 100 ton | 99.100 | 80.200 | 31.597 | 31.501 | 22.941 | 17.557 | 10.156 | 10.000 | 380.000 |
| Number of inhabitants | 189.300.000 | 224.800.000 | 57.600.000 | 95.900.000 | 53.500.000 | 47.800.000 | 50.300.000 | 700.000.000 | 3.150.000 |
| Production of Steel/capita | 524 KG | 357 KG | 549 KG | 328 KG | 429 KG | 367 KG | 202 KG | 14 KG | 121 KG |

TABLE 5

WORLD CRUDE STEEL PRODUCTION IN 1957 AND 1961 (IN THOUSAND TONS)

| COUNTRY | | | 1957 | 1961 |
|---|---|---|---|---|
| AFRICA | U.A.R. | | 107 | 233 |
| | Algeria | | 15 | 16 |
| | Southern Rhodesia | | 65 | 80 |
| | Union of South Africa | | 1740 | 2472 |
| | | TOTAL | 1927 | 2901 |
| FAR EAST | Taiwan | | 89 | 125 |
| | China | | 5350 | 18000 |
| | India | | 1742 | 3840 |
| | Japan | | 12564 | 23268 |
| | North Korea | | 277 | 660 |
| | Pakistan | | 12 | 15 |
| | Philippines | | 50 | 65 |
| | Others | | 10 | 10 |
| | | TOTAL | 20094 | 50983 |
| OCEANIA | Australia | | 3060 | 3936 |
| | | TOTAL | 3060 | 3936 |
| LATIN AMERICA | Argentina | | 222 | 441 |
| | Brazil | | 1299 | 2443 |
| | Chile | | 389 | 391 |
| | Colombia | | 114 | 192 |
| | Cuba | | - | - |
| | Mexico | | 688 | 1682 |
| | Peru | | 30 | 75 |
| | Uruguay | | 10 | 9 |
| | Venezuela | | 20 | 71 |
| | | TOTAL | 2772 | 5308 |
| UNITED STATES NORTH AMERICA | | | 102225 | 88920 |
| | Canada | | 4572 | 5868 |
| | | TOTAL | 106827 | 94788 |
| USSR | | TOTAL | 51043 | 70751 |
| WESTERN EUROPE | ECSC | | 59803 | 73239 |
| | United kingdom | | 22047 | 22411 |
| | others | | 8751 | 12331 |
| | Eastern Europe | | 16173 | 22745 |
| | | TOTAL | 106974 | 130756 |
| | | TOTAL WORLD | 292637 | 359549 |

PART II

In the following, the product mix in different countries is given for recent years tables 6 and 7 and the percentage of each product to the total production, and also the increase or decrease of apparent consumption per inhabitant. (Table 8)

TABLE 6

PRODUCTION OF FINISHED STEEL IN INDIA

1962

| Quality | Production per month in tons | Percentage |
|---|---|---|
| Heavy sections & railway accessories | 96200 m/tons | (31.6) |
| Flats | 95100 m/tons | (31.2) |
| Bars and rods | 111000 m/tons | (36.4) |
| Spring & tool steel | 2100 m/tons | ( 0.6) |

TABLE 7

PRODUCTION OF FINISHED STEEL PRODUCTS (EXCLUDING FINISHED STEEL CASTINGS AND FORGINGS, 1958-1961
THOUSAND OF TONS AND PERCENTAGES

| Country and year | | Finished steel total | Strip. | Plates | Sheets | Heavy sections | Light sections | Wire rids | Other products |
|---|---|---|---|---|---|---|---|---|---|
| France | 1958 | 11271(100) | 683(6.1) | 1271(11.3) | 2926(25.9) | 736(6.5) | 3020(26.8) | 1118(9.9) | 1517(13.5) |
| | 1961 | 14164(100) | 982(6.9) | 1588(11.2) | 3807(26.2) | 896(6.2) | 3522(24.9) | 1663(11.7) | 1726(12.2) |
| United Kingdom | 1958 | 14796(100) | 1215(8.2) | 2629(17.8) | 3441(23.3) | 1678(11.3) | 2582(17.5) | 1174(7.9) | 2077(14.0) |
| | 1961 | 16663(100) | 1446(8.7) | 2825(17.0) | 3754(22.5) | 2038(12.2) | 3152(18.9) | 1389(8.9) | 2059(12.4) |
| W.Germany | 1958 | 17420(100) | 1450(8.3) | 3518(20.2) | 2276(13.1) | 1262(7.3) | 4613(20.7) | 1467(8.4) | 3834(22.0) |
| | 1961 | 225686(100) | 2047(8.0) | 4520(17.6) | 2990(11.7) | 2109(8.2) | 6041(23.5) | 2094(8.1) | 5877(22.9) |
| Yougoslavia | 1958 | 813(100) | 37(4.6) | 103(12.2) | 81(10.0) | 14(1.7) | 336(41.3) | 54(6.6) | 188(23.1) |
| | 1961 | (100) | 36(3.2) | 112( 9.8) | 95( 8.3) | 18(1.6) | 495(43.4) | 117(10.3) | 267(23.4) |
| Hungary | 1958 | 1309(100) | 57(4.4) | 186(14.2) | 81( 6.2) | 223(17.0) | 338(25.8) | 96( 7.3) | 329(25.1) |
| | 1961 | " | " | " | " | " | " | " | " |
| Romania | 1958 | 633(100) | 17(2.7) | 59(2.7) | 89(14.1) | 38(6.0) | 250(39.5) | 76(12.0) | 104(16.4) |
| | 1961 | 1520(100) | 18(1.2) | 108.(7.1) | 161(10.6) | 148(8.7) | 360(23.7) | 113(7.4) | 612(40.3) |
| USSR | 1958 | 37572(100) | 2041(5.4) | 4568(12.2) | 5424(14.4) | 15384 | (41.0) | 2934(7.8) | 7221(19.2) |
| | 1961 | 48462(100) | 3166(6.5) | 7695(15.9) | 5925(12.2) | 1444(29.8) | 4662( 9.6) | 3902(8.1) | 8669(17.9) |

TABLE 8

TREND OF APPARENT CONSUMPTION IN SELECTED REGIONS AND COUNTRIES
1938 - 1957 - 1961

(THOUSAND OF TONS OF CRUDE STEEL EQUIVALENT AND KG PER CAPITA)

| Region & country | 1958 1000 t.kg/ | capita | 1957 1000 t.kg/ | capita | 1961 1000 t.kg/ | capita | Increase of apparent consumption/ 61/938 | Decrease consumption inhabitant 61/957 |
|---|---|---|---|---|---|---|---|---|
| Far east | 11306 | 10.4 | 85.590 | 18 | 53.256 | 32 | 308 | 178 |
| China (mainland) | 1267 | 3.8 | 5.544 | 8.8 | 18.289 | 25 | 893 | 284 |
| India | 1237 | 3.5 | 3.619 | 8.9 | 5.154 | 12 | 343 | 135 |
| Japan | 5929 | 84.0 | 12.627 | 139.0 | 25.763 | 294 | 326 | 197 |
| MIDDLE EAST | 409 | 8.0 | 1.459 | 20.0 | 1.803 | 23 | 288 | 115 |
| AFRICA | | | | | | | | |
| Union of South Africa | 919 | 82.0 | 2.222 | 137.0 | 2.380 | 132 | 161 | 96 |
| LATIN AMERICA | | | | | | | | |
| Argentina | 695 | 50.0 | 1.409 | 71.0 | 2.379 | 113 | 226 | 159 |
| Brazil | 328 | 8.3 | 1.876 | 31.0 | 2.701 | 37 | 446 | 119 |
| Chile | 138 | 29.0 | 498 | 70.0 | 506 | 65 | 224 | 93 |
| Columbia | 89 | 10.3 | 275 | 21.0 | 405 | 28 | 272 | 133 |
| Mexico | 205 | 11.0 | 1.351 | 43.0 | 1.840 | 51 | 464 | 119 |
| Venezuela | 129 | 7.0 | 1.556 | 254.0 | 448 | 59 | 159 | 23 |
| NORTH AMERICA | | | | | | | | |
| United States | 40456 | 314.0 | 97.178 | 568.0 | 89694 | 488 | 155 | 86 |
| WESTERN EUROPE | | | | | | | | |
| Denmark | 553 | 147.0 | 912 | 203.0 | 1233 | 267 | 182 | 136 |
| France | 5457 | 132.0 | 13.594 | 301.0 | 14167 | 308 | 233 | 102 |
| Turkey | 164 | 10.0 | 298 | 12.0 | 549 | 20 | 200 | 167 |
| United Kingdom | 10921 | 227.0 | 19.022 | 370.0 | 18838 | 357 | 157 | 96 |
| W. Germany | 10921 | 227.0 | 21.097 | 400.0 | 27571 | 490 | 157 | 123 |
| Yugoslavia | 261 | 17.0 | 1.124 | 62.0 | 1881 | 101 | 594 | 163 |
| EASTERN EUROPE | | | | | | | | |
| Bulgaria | 261 | 17.0 | 517 | 67.0 | 871 | 110 | 594 | 164 |
| Hungary | 459 | 50.0 | 1.514 | 154.0 | 2168 | 216 | 432 | 140 |
| Romania | 427 | 22.0 | 1.530 | 86.0 | 3179 | 171 | 777 | 199 |
| USSR | 17523 | 103.0 | 49.337 | 243.0 | 68382 | 314 | 305 | 129 |

Special attention is given to the Far East, Middle East and the Latin America countries. The steel consumption per inhabitant is ranging established in developing between 12 kg. - 60 kg. This indicates the probable range for the size of plant to be established in developing countries in Africa.

TABLE 9
STEEL
RATES OF INCREASE OF CRUDE PRODUCTION AND ESTIMATED RATES OF INCREASE OF CAPACITY IN SELECTED PERIODS 1939 to 1961
(PERCENTAGES)

| COUNTRY | 1957 over 1939 | 1960 over 1959 | 1961 over 1960 |
|---|---|---|---|
| UNION OF SOURH AFRICA | 346.2 | 11.4 | 17.0 |
| MIDDLE EAST | - | 30.3 | 0.9 |
| FAR EAST | 139.0 | 34.9 | 8.9 |
| China (mainland) | 881.7 | 38.2 | - 2.4 |
| India | 63.3 | 33.0 | 16.8 |
| Japan | 87.6 | 33.1 | 27.7 |
| LATIN AMERICA | | | |
| Argentina | 1010.0 | 29.4 | 59.2 |
| Brazil | 1039.5 | 54.7 | 7.1 |
| Chile | - | 8.7 | - 13.3 |
| Mexico | 793.5 | 45.2 | 14.1 |
| UNITED STATES | 113.5 | 6.2 | - 1.3 |
| U.S.S.R | 190.0 | 8.9 | 8.4 |
| EUROPE (EXCLUDING USSR) | | | |
| ECSC | 65.9 | 15.3 | 0.6 |
| United Kingdom | 64.1 | 20.4 | - 9.1 |
| Other Western Europe | 197.4 | 14.1 | 7.4 |
| Eastern Europe | 148.0 | 9.4 | 7.9 |
| TOtal World | 115.0 | 13.5 | 2.9 |

This table shows that the increase in production does not follow a certain rule, but there is sharp leap at first, slows down and may even show a retreat in production in some periods and after a certain period it starts to increase sharply.

## STEEL MARKET IN AFRICA

- According to the report of the United Nations Economic Commision for Africa the existing market is as follows: The consumption of steel per head is very low averaging about 6 kg per head over East and West Africa, in Algeria consumption is about 36 kg per head, in the UAR 16 kg. per head.
- There is prospect of increase in consumption of steel.
- The current demand for steel in Africa is most largely for use in building and construction followed by general maintenance and repair work.
- The pattern of demand determines the finished products required which consists in all regions of over 1/3 for reinforcing concrete bars and sections for building and construction work, 1/5 for galvanized sheet for roofing and general construction purposes in West and East Africa, ¼ for railway material and pipes, especially in North Africa and about 1/5 for wire and wire rod, flat products (plain sheet, plate, tinplate and strip).

In particular, none of the national areas of the African continent, with the exception of Egypt and Algeria, can at the present time, and on its own, offer a large enough market to fully justify the erection of a modern integrated iron and steel unit with an annual output of at least 250.000 tons of finished steel.

## DISCUSSION OF SIZE OF PLANT

The main trends in iron and steel making in recent years may be summarized as follows:

(1) Better preparation of raw materials.

(2) Intensification of metallurgical processes particularly by the widespread use of oxygen.

(3) Increased size of production units and of complete iron and steel works.

(4) The introduction of continuous processes and the closed integration of the different stages of production.

(5) The wider application of automatic controls leading to a further increase in the scale of operations.

Characteristic features of iron and steel industry processes are the great bulk of the raw materials used and the massive plant equipment needed to handle these materials. Furthermore, capital costs are high and large scale production essential to spread the incidence of capital charges.

The optimum economic size of an integrated iron and steel works in a highly industrialized country is already of the order of 3 million ingot/ton per annum.

It is still possible to install economic units of a much smaller capacity than the up-to-date optimum size plants which are being installed in the USA and the USSR.

None of the African countries, with the exception of the UAR & Algeria can at the present time offer a large enough market to fully justify the erection of a modern integrated iron and steel unit.

- Steel production in most African countries to-day is based on the smelting of locally available scrap.
- The initial size of the plant should be determined on the basis of the existing market. The possibility of flexible expansion in stages to cope with market growth over a period of ten to twenty years should be taken into consideration when designing the plant. Local conditions and the availability of raw materials influence the decision for the type and initial size of the plant.
- The plant would preferably be in the form of a progressive installation of rolling mills, then steel furnaces, then an iron making facility, if local conditions so dictate.
- Heavy profiles are hardly used in Africa for construction work, such structures have mostly been replaced by reinforced concrete bars.

- The approach to find the optimum size of the plant, can be based either on:

(1) Fixing a minimum steel consumption per head and multiplying this by the population of the country.

As previously seen from the product mix and steel consumption in different countries especially the UAR, Latin America, India and China. This figure should range between 10-20 kgs/inhabitant.

(2) According to the experience gained we think that a progressive plant of capacity 50.000 tons of finished products is the most suitable. Such units are continuously built and ordered for nowadays. It can be projected as follows:

a- The installation of a merchant and wire rod mill for the manufacture of rounds, wires and small angles.

b- According to local conditions the initial materials can be:

1. Imported billets.
2. Billets from steelmaking furnaces for converting local scrap iron, supplemented with imported pig iron for the production of billets.

c- Blast furnace or electric shaft furnace to be installed for the production of pig iron using local iron ore and charcoal or coke.

Annual production of 50.000 tons should be the minimum size of any plant. The rolling mills need not be automated or fully mechanized in the 1st stage, but it should allow for such modernization.

The increase in production due to better utilization of the installation may balance the increase in the population up to a certain point.

- Each developing country should build its experience and produce by these comparatively small units taking into consideration that bigger integrated steel plants should be eventually installed to fulfil the following goals:

(1) Satisfy a growing home market.

(2) Export excess production to neighbour countries, preferably on an exchange basis for other steel products.

## STEEL QUALITY

- Steel production should be of the normal qualities 37 kg/$m^2$ and according to DIN 17100 and no alloy steel to be forseen in the 1st stages.

- In Africa, due to the distances between the countries, the resulting transport costs would suggest the advisability of grouping together neighbouring countries to study the prospects of the installation of large integrated plants as a joint venture, within each group.

  This allows installation of plants of maximum economical size and the finished products can be divided between them, aiming for regional integration in the area.

- All measures should be taken for ensuring a smooth progress of the whole development programme. This necessitates the establishment of an exact time schedule. According to it, it will be possible to meet the requirements fixed in the industrial plan for rolling mill products.

## CONCLUSION

The installation of the iron and steel industry in developing countries is inevitable, the question that remains is that of timing. The Standardization of specifications of the finished products is of utmost importance. The plant should be modern and up to date and should allow for further modernization and expansion.

A long-term programme of development should be forseen in the planning stages. The unit should have a capacity of not less than 50.000 tons of reinforced concrete bars and may be light sections (angles, flats) as well, mainly of commercial quality and plain carbon steels for general use. The history of the steel industry in the UAR as shown in the production programme and the expansion for the future presents a model for the right approach for a good start.

The production programme and the choice of product mix for the steel works should allow for sub-regional specification. This forwards the possibility of:

(1) Installing plants of economic size.
(2) Possibility of co-ordinating their output of finished steel.